



# AD PM Hipped Parts Offering

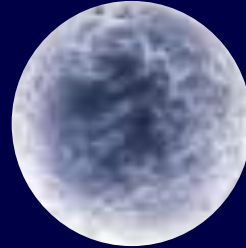
April 2010



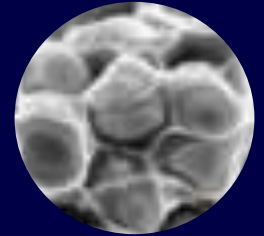
1st caution : Gas-atomized powders are only a minor part of powder metallurgy



**Nickel powders**  
(by chemical process)

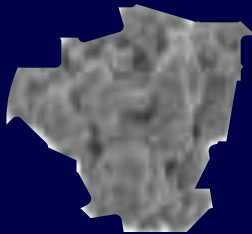


**PM steels**  
(gas-atomized)



**Tungsten powders**  
(by chemical process)

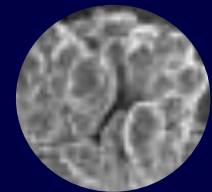
# The galaxy of powder markets



**Iron and steel powders**  
(water-atomized)



**Cobalt powders**  
(by chemical process)

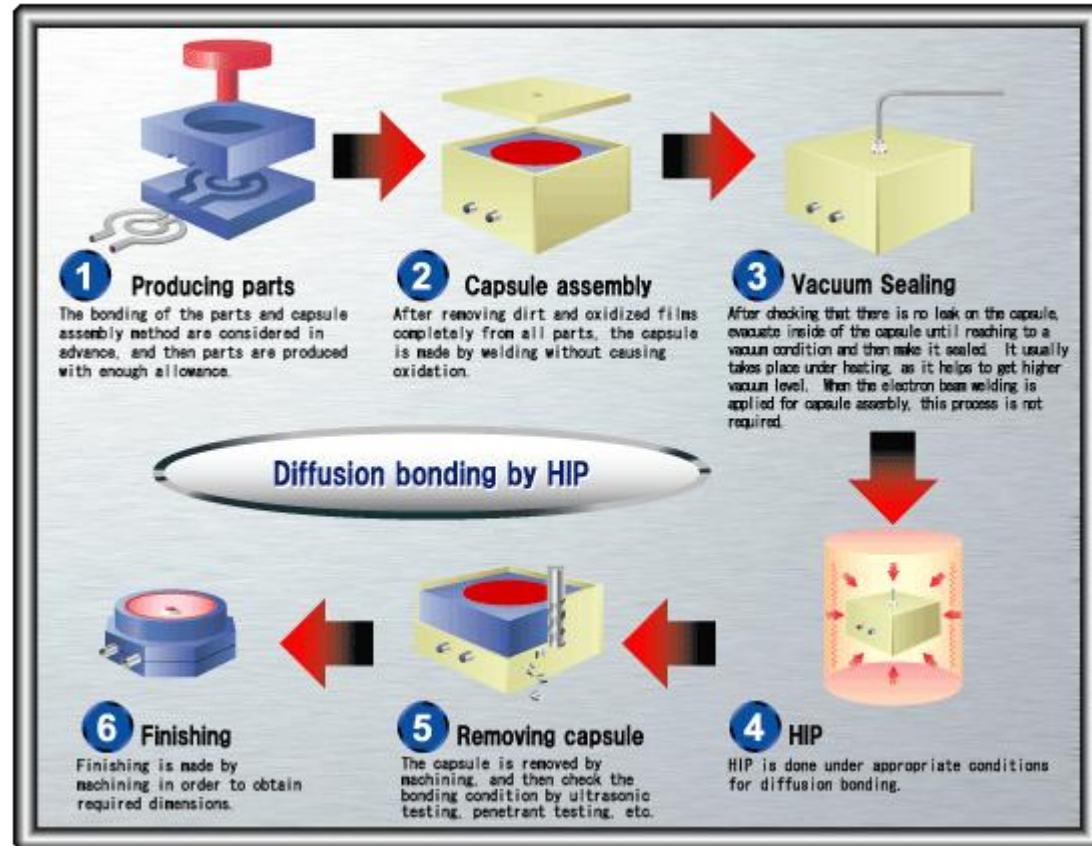
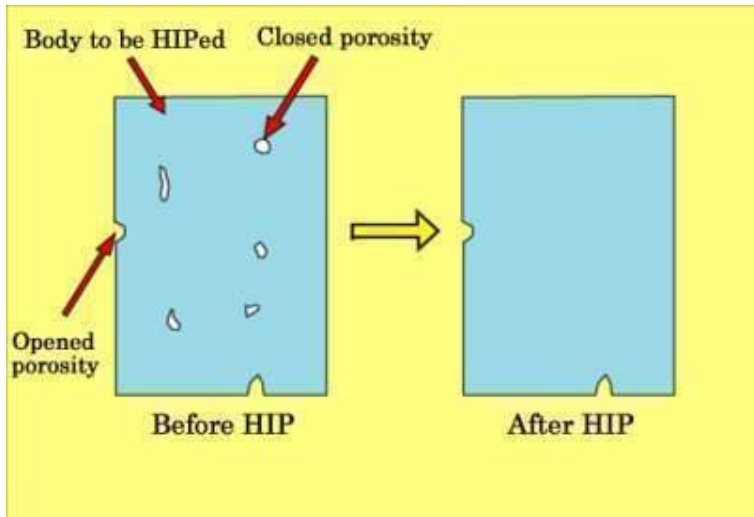


**Copper-base powders**  
(by chemical process)

2d caution: HIP technology not only used for powder compaction, but also for...

Casting densification

Diffusion bonding



=> Bear it in mind when speaking about HIP with customers

# AUBERT&DUVAL Eramet Alliages Powder Businesses

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## Aubert & Duval Business



1. PM superalloys for turbines
- 2. PM Hipped NNS and bimetal parts**
3. PM version of alloys and super-alloys

## Erasteel Business



1. ASP long and flat products
2. Fe, Ni, Co-base **powders** for HIP, PTA and other powder markets





## HIP PM NNS process steps

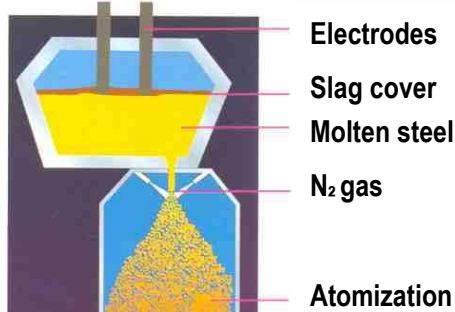
- 1. Powder manufacturing**
- 2. Part & container design**
3. Container manufacturing
- 4. Powder filling – vibration packed into container**
- 5. Container sealing**
6. HIP consolidation
- 7. Post – Heat treatment if necessary**
- 8. Container removal (by machining or pickling)**
- 9. Inspection (NDT, mechanical testing...)**
- 10. Finish machining**

In **RED** : where Eramet Alloys expertise lays

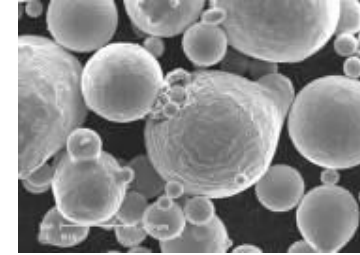
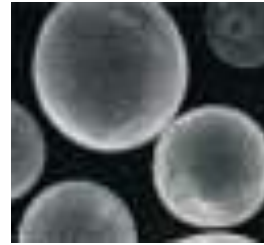




## Gas atomization process



## Pre-alloyed spherical powders



## Alloy types

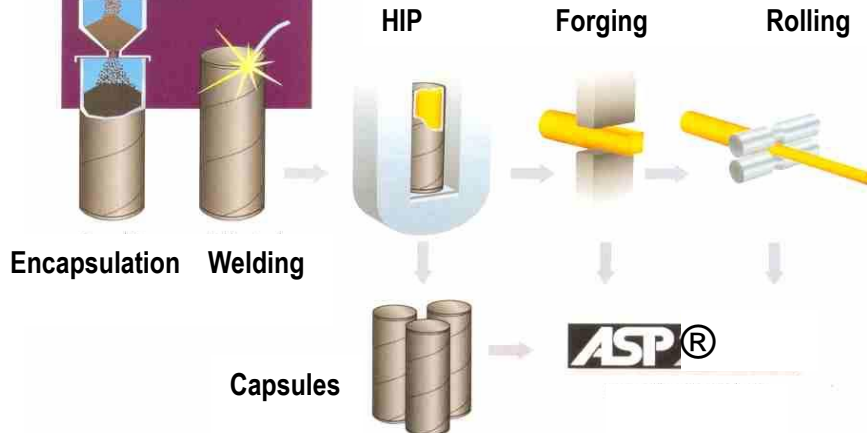
Steels

- High Speed steels
- Tool steels
- Stainless steels
- Low alloyed steels
- Etc.

Ni-, Co-  
base

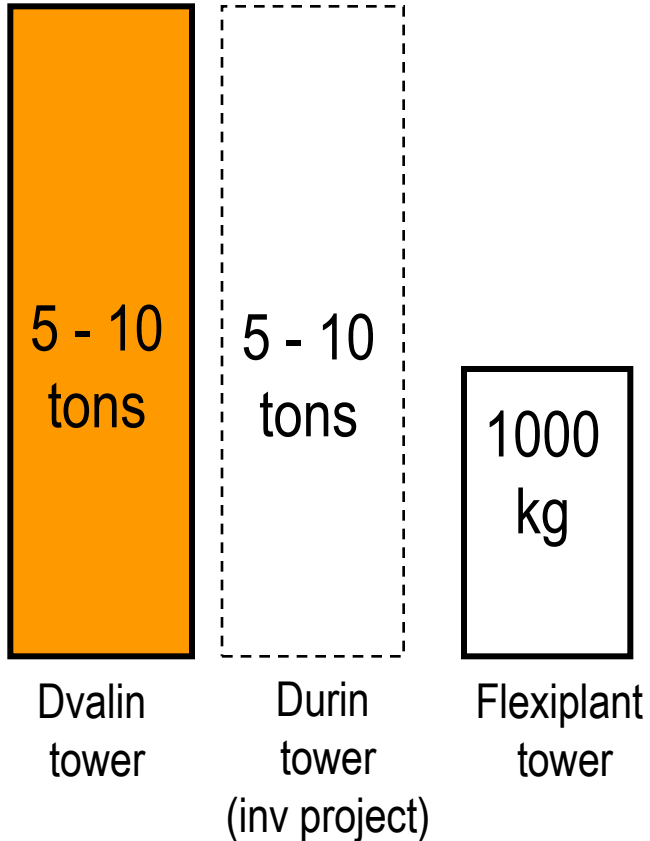
- Inconel®
- Stellite®
- Etc.

Ti



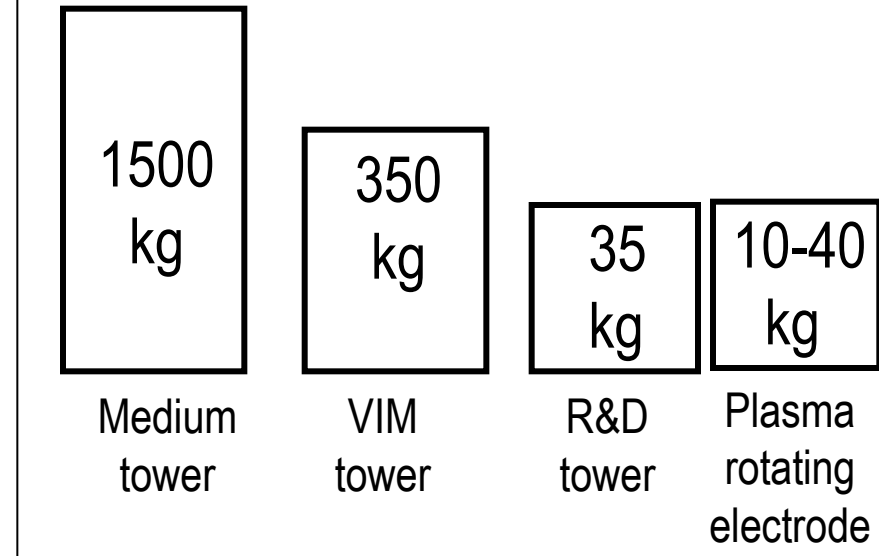


**Söderfors, Sweden**



High speed steels & Tool steels  
Stainless steels  
Ni-base & Co-base

**Imphy, France**

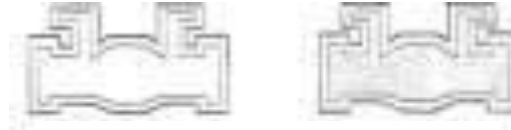


Boron Containing grades  
Super-alloys  
All  
Titanium



## Process : NNS hipping

1. Manufacturing of near net shape container

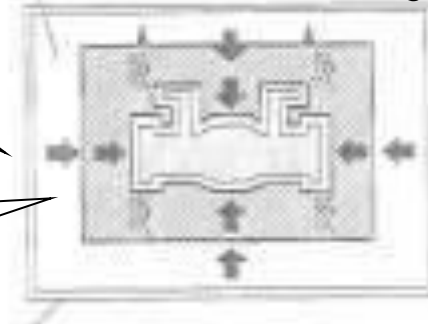


2. Filling with powder

Compaction of metal powders at high temperature and high pressure

Pressure is applied to the material from all directions (hence the term "isostatic").

3. Hot Isostatic Pressing



4. Near net shape part



### PM HIPPED ALLOYS :

- Fe base primarily: tool steels, stainless steels, low alloyed steels
- Ni and Co base alloys
- Titanium alloys

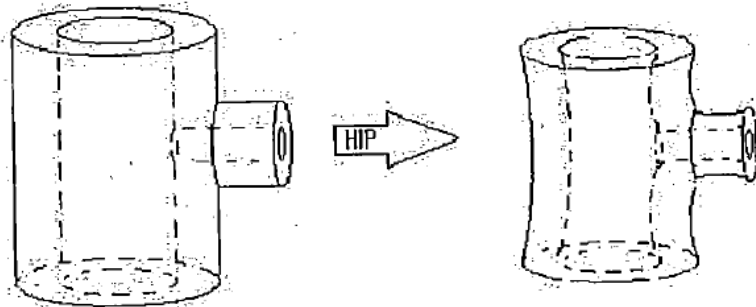




# Hipping Equipment

**Maximum Size :** before hipping, the container must enter the  $\varnothing$  1100 mm - H 2400 mm hipping chamber (TCS Bodycote plant), i.e. Part weight from a few kilos up to 15 tons

**Series :** typically 1 to 10 units (but in one case : 500 !). Whenever possible, full hipping chamber load



Before Hipping

After Hipping

**Be careful !**



For monometal parts, shrinkage of approx 30% (hour-glass effect)



## Process : bimetal parts

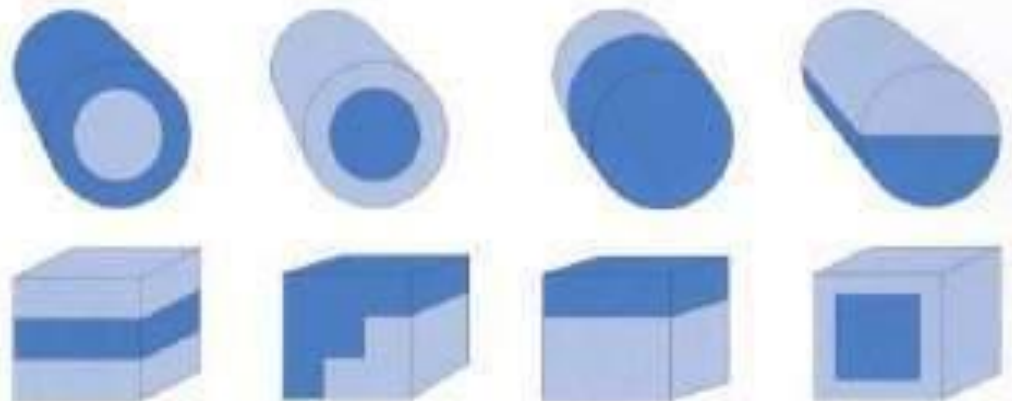


**Copper CuC1/SS304  
LHC component**



**Vanadis 10/Mn  
steel crusher**

### Geometries in Composites



By correct choice of the base form and a preparatory work which fixed the Stop measures the most different geometries can be manufactured of 2 or more materials.

Source: Kennametal HTM

HIP is the **only technology** combining material consolidation and bimetal/multimaterial option





# Competition - Key players in the PM HIP NNS market

## NORTH AMERICA

US ATI (ex Crucible)

US Alcoa Howmet

US Kittyhawk

US PTI

US Bodycote

US NFM and Entek

US Synertech

US SMC (PCC)\*

US Wyman Gordon (PCC)\*

US HMI\*

### Legend

*Black:* Design companies

*Red:* HIP service companies

*Green:* HIP service or design for plastics

*Blue:* PM Superalloy for aero

\*VIM atomization

## EUROPE

SE, B, F, DE Bodycote

SE Sandvik Powdermet

CH Kennametal HTM

DE Saar Hartmetall

FI Metso

DE Doncasters

CH Hempel

## JAPAN

Kinzoku Giken

Kuroki

Kubota

JSW

For further details on competition, click [HERE](#) :



- Price Definition : Market Manager
  - Pierre Rega (aero-engines)
  - Cathy Sentenac (land turbines and compressors)
  - Jean-Pascal Hesse (nuclear)
  - Grégor Philippe (oil & gas)
  - Frédéric Cenac (tooling)
  - Jean-Philippe Planchon (automotive)
  - Didier Lavèze (pumps and specialties)
  - Other Market/Account Managers to be designated when necessary.
- Basic Leadtime for Offer : 4 weeks
- Technical Support/Review : Sylvain Favier (Imphy)
- Order Processing and Monitoring : Edwige René (Imphy)

